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ABSTRACT

This study examined interaction and communication patterns among students (n=9) and with the instructor in a graduate course offered at a distance using the FirstClass computer conferencing (CC) software. Specifically, the following questions were addressed: (1) What are similarities and differences in interaction and collaboration between CC and face-to-face learning environments? (2) How does the medium of exchange in CC encourage or discourage online discussion? (3) What collaborative learning strategies are used in CC? and (4) What is the instructor's role in the CC environment? Data sources consisted of transcripts of all computer conferences, real-time (synchronous) chats, and students' electronic journals about CC; results of pre- and post-course CC attitude surveys; and notes from semi-structured interviews with participants. Data analysis was done using the constant comparative method. Figures include: the FirstClass desktop; the code words found in each type of conference; a flow chart of the types of asynchronous conferences; and summaries of the types of messages in student-moderated, instructional, auxiliary, and metacognitive conferences. Qualitative results are discussed related to each of the four research questions. The instructor's role in computer conferencing is analyzed. (Contains 26 references.) (DLS)

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Interaction and Collaboration via Computer Conferencing

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Abstract

Computer conferencing is becoming an increasingly important tool in university course delivery. This study addresses ways in which computer conferencing impacted interaction and communication patterns among students and with the instructor in a graduate course. Primarily through qualitative research methods, we address the use of a widely used computer conferencing software program in an academic setting. We also identify instructional and learning strategies in a constructivist paradigm, and we analyze the instructor's role in computer conferencing.

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Introduction

Networked computers have been used in academic course delivery in the United States since as early as the 1980s, and their use grew significantly in that decade. Hiltz (1994) describes a Virtual Classroom™ as a teaching and learning environment located within a computer-mediated system. Rather than being built of bricks and boards, it consists of a set of group communication and work "space" and facilities, which are constructed in software (p. 3).

A number of studies have examined the benefits and challenges associated with this educational delivery system (Berge, 1997; Burge, 1994; Harasim, 1990; Hiltz, 1994). Key benefits of computer conferencing include providing equal access for interaction, fostering collaboration, allowing for learner reflection, and supporting learner interaction. Challenges to the use of computer conferencing include unequal access to hardware and software, a steep learning curve, the reliance on text-based communication, and managing large amounts of information and communication.

Computer conferencing has been used in university classes as an adjunct to face-to-face and distant delivered instruction (Murphy, Cathcart, & Kodali, 1997; Yakimovicz & Murphy, 1995) as well as the primary mode of communication (Eastmond, 1995; McIsaac & Ralston, 1996). These university settings provide powerful evidence of the ways that computer conferencing is used to provide opportunities for collaborative learning and sharing of multiple perspectives, both of which are integral to constructivist learning environments (Wilson, 1995).

Of the many computer conferencing software programs available, FirstClass™ (FC) is currently the most widely used (Bates, 1995). The FC environment provides for discussions on organized topics, uploading and downloading files, real-time text-based chat rooms, conference messages, collaborative document writing space, and private email. All of these functions were used in the class and examined in this study.

This study addresses the manner in which computer conferencing enhanced communication and interaction patterns among graduate students in a course offered at a distance. We identify the capabilities and challenges of computer conferencing, and we address the similarities and differences in the use of computer communication and face-to-face interaction strategies. We also describe how the medium of exchange in computer conferencing encourages online discussion and fosters collaborative learning. We examined the instructor's expanded role in the computer conferencing environment.

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Theoretical Framework

Constructivism is the paradigm or world view that recognizes learning as the process of constructing meaning about, or making sense of, our experiences. Qualitative researchers "attempt to understand the meaning of events and interactions to ordinary people in particular situations" (Bogdan & Biklen, 1992, p. 34). Through working in collaborative groups (Brown & Palincsar, 1989) and learning in authentic environments (Brown, Collins, & Duguid, 1989), learners are encouraged to develop personal meaning. Computer conferencing is increasingly the means by which "learners actively construct knowledge by formulating ideas into words that are shared with and built upon through the reactions and responses of others" (Harasim et al., 1995, p. 4).

Garrison (1989) identifies two-way interaction as a critical feature of the educational process. In a computer conferencing environment, this communication takes place via technology and is embedded in instructional methods that provide for interaction (Wagner, 1994). Interaction is necessary not only for students to receive feedback on their progress, but also to engage learners in active learning. Computer conferencing should include interactive elements that require learners to construct meaning actively within the computer-based environment. Research indicates that higher levels of interaction typically lead to more positive attitudes toward and greater satisfaction with learning (Hackman & Walker, 1990). Interaction in distance education typically occurs between the learner and the content, the learner and the instructor, and the learner with other learners (Moore, 1989). More recently it has been noted that interaction is critical between learners and the technology, particularly with high technology communication devices (Hillman, Willis, & Gunawardena, 1994).

Researchers have reported on the remarkable contributions of computer conferencing to collaborative learning (Davie & Wells, 1991; Harasim et al., 1995; Hiltz, 1994). Collaborative learning and computer conferencing are reciprocally related: while computer conferencing depends on the ability and willingness of participants to collaborate, collaborative learning is enabled by computer conferencing (Cifuentes, Murphy, Segur, & Kodali, in 1998). Romiszowski and Mason (1996) posit that computer-mediated communication provides for two opposing paradigms: instructional, or traditional education, and conversational, which occurs in collaborative learning environments. This conversational style is evident in "learning environments that are more authentic, situated, interactive, project-oriented, interdisciplinary, learner-centered" (Berge, 1997, p. 13).

Overview

In a semester-long university course, graduate students at Texas A&M University used FC software from their own sites or a university computer lab to communicate with each other and with the instructor as an adjunct to the weekly class sessions held by two-way interactive videoconference. Specifically, the students in this interactive, project-oriented course used the asynchronous communication features of the text-based FC system to turn in assignments, moderate conferences, participate in other's conferences, conduct collaborative writing projects, attach files, and conduct real-time discussions through the synchronous chat mode. The students accessed FC from centrally located computer laboratories on the university's main campus, from their own locations via modem with a PPP or SLIP connection, or from other locations with a direct connection to the Internet. With the exception of two occasions on which technical problems prevented access to the server from outside of the local area, students had ongoing access to FC.

The instructor set up the conferences on the FC desktop throughout the semester. Individual icons on the desktop represented the 19 first-level, asynchronous conferences. By the end of the semester, six of the conferences contained between two and eight sub-conferences each. In only one conference was there an additional level of sub-conferences (see Figure 1 for a scanned image of the FC desktop). Although the FC desktop doesn't reflect real-time chats, the students used live chats with the entire class on the three occasions that they did not meet via interactive videoconference. Additionally, as they became more familiar with the chat mode during the semester, students and instructor alike chatted on informal bases with one or two others at a time.

Figure 1: FirstClass Desktop

Objective

Patterns of communication and the process of constructing meaning in formal education can be profoundly affected by computer conferencing, particularly in university courses in which students do not meet face-to-face on a regular basis. To determine the patterns of communication in computer conferencing, we asked the following questions: 1) What are similarities and differences in interaction and collaboration between computer conferencing and face-to-face learning environments? 2) How does the medium of exchange in computer conferencing encourage or discourage online discussion? 3) What collaborative learning strategies are used in CC? 4) What is the instructor's role in the computer conferencing environment?

Methods

The research team consisted of the instructor and two graduate students, one from the course that was studied and another from a similar course during the same semester. The three researchers collaborated near the end of the semester in the process of data collection, analysis, writing, and rewriting.

Subjects

The subjects of the study were the nine registered students and the instructor of the class. The students had wide-ranging initial expertise and interest in telecommunications in a range from little to no experience with e-mail prior to the beginning of the semester to telecommunication professionals who work in the field. Adding to the complexity of communication were two students whose second language was English.

The pre-course surveys revealed that more than half of the nine students reported having minimal or no experience at all with distance education prior to the beginning of the semester. The majority of the six doctoral and three master's students indicated that they preferred to take the class via distance technologies and felt that the course would hold their attention. The students generally anticipated that they would take more responsibility for

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learning in this class than in a more traditional classroom and that they would achieve as much in this course as in a course taught by more traditional means. They each expected that active communication and interaction with the instructor and their classmates to be as good as it would be in a traditional class. Each expected that the course would help them learn to communicate easily with students in other locations. Several of the students identified their primary reason for enrolling in this elective course as gaining experience in distance learning technologies and resources.

Data Collection and Analysis

At the end of the semester, we downloaded and printed the electronic file of messages from all of the asynchronous conferences and the logs of the live chats. The data sources included transcripts of all computer conferences, real-time (synchronous) chats, and students' electronic journals about computer conferencing; results of pre-course surveys and post-course computer conferencing attitude surveys; and notes from semi-structured interviews with participants.

By using the constant comparative method (Bogdan & Biklen, 1992), we discovered from the student data and emergent categories during the analysis process that we needed to modify our research questions. This method is not a step-by-step process. Instead, it is a dynamic process involving all actions: collecting data; looking for key issues, which become categories of focus; looking for data that provide many incidents of the categories of focus; writing about the categories being explored; and attempting to describe and account for all incidents in data while continually searching for new incidents.

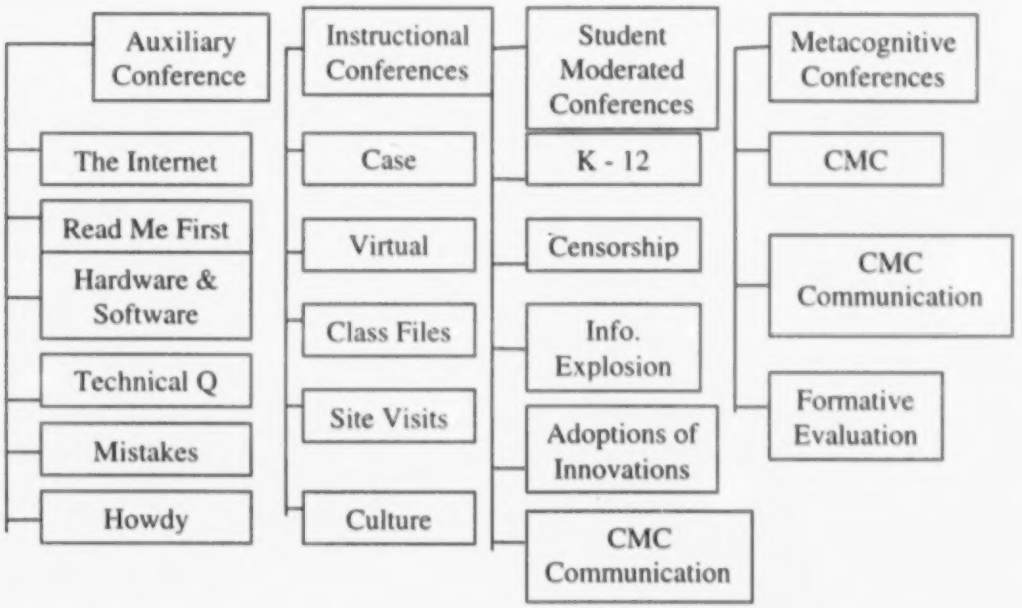
In this study, prior to data analysis, we reviewed the literature for similar studies and to understand data categories identified by previous research. We coded and categorized the data from the transcripts by having one researcher go through the data and evaluate each message based upon the type of information or communication contained in the transcript. The two other researchers then reviewed, discussed, and revised the coded categories as a measure of coding reliability. For example, while individually reading the transcripts, we highlighted and assigned code words to identify the types of interactions or communications that we thought were taking place. Examples are "response to peers," "strokes" (verbal affirmations), and "modeling by experience sharing." We then looked at the codes to determine natural categories. Most of the code words occurred many times in the data; in addition, some of the codes collapsed into larger categories.

We established the following codes to identify quoted messages, which are written precisely as the authors wrote them in the conferences. The author of the message is "I" for Instructor and "S1" - "S9" for the nine students. The four types of conferences that emerged from the data were: auxiliary (outside of the curriculum of the class), instructional (led by the instructor), student-moderated, and metacognitive (shared student reflections). Of the four types of conferences, one was originally student-moderated and later became metacognitive. We identified the conferences by initials; thus, CMC Communication (student-moderated) was "CC-S," while CMC Communication (metacognitive) was "CC-M." The date of each message was also included. For example, a message that Student 5 wrote in the student-moderated section of CMC Communication on October 10, 1996 would be identified with this description following the direct quotation from the transcript: [S5, CC-S, 10/10/96]. The emergent categories that were identified in each type of conference are listed in Table 1 below. Three of the four instructional conferences had several sub-conferences, and in two of the conferences were sub-conferences arranged for small groups to discuss issues and post their paced assignments for each other. Figure 2 is a flow chart of the four types of conferences and the specific conferences that fell into each type.

Table 1: The Code Words Found in Each Type of Conference

Student Moderated Conferences	Instructional Conferences	Auxiliary Conferences	Metacognitive Conferences
Discussion questions	Instructions	Instructions	Perceptions
Response to peer	Strokes	Resource sharing	Instructional strategies
Modeling by experience sharing	Instructional questions	Technical feedback	Impact
Waving	Response to instruction	Technical questions	Barriers
Peer thank you	Opinions	Response to peer	Communication strategies
Closure	Project update	Peer thank you	Response to instructor
Opinion	Response to peer	Information sharing	
Experience sharing	Resource sharing		
Response to moderator	Peer thank you		
Technical feedback	Technical feedback		

Figure 2: Flow Chart of the Types of Asynchronous Computer Conferences



Findings

Following are the findings related to the research questions. A summary of the types of messages in each of the four conference categories is reported in Figures 3, 4, and 5. These three figures identify the types of interaction and communication that took place among the participants. Figure 3 reports student-moderated conferences. The instructor took a minor role in these student-moderated conferences. The largest number of interactions in this conference type was the 51 opinion messages posted by students. The next highest level of interactions in this category was student responses to peers. In Figure 4, instructional conferences are listed. These conferences were instructor-led and in large part had no moderator. The largest number of postings in these conferences was the 43 student "Response to Instruction" messages. The second most frequent message category was student "Opinions."

Figure 5 lists auxiliary conferences, which were conferences established for interactions that were outside of the curriculum of the course. Examples are "Howdy" for students to get acquainted with each other and other technical and administrative topics. The largest number of interactions in this category was student "Resource Sharing" with 21 messages. The second most frequent postings were "Response to Peer" which were students giving feedback to each other.

Figure 3. Student Moderated Computer Conferences (K - 12, Censorship, Information Explosion, Adoptions of Innovations, CMC Communications)

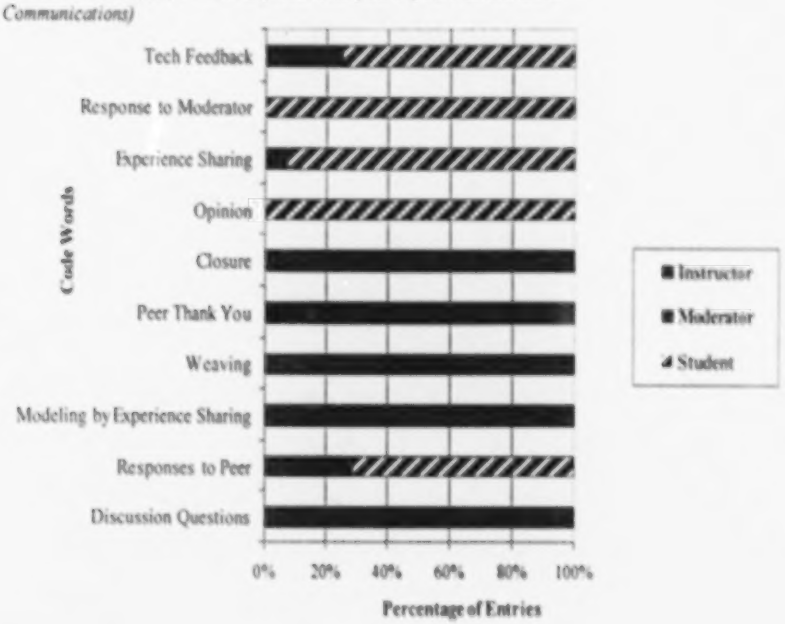
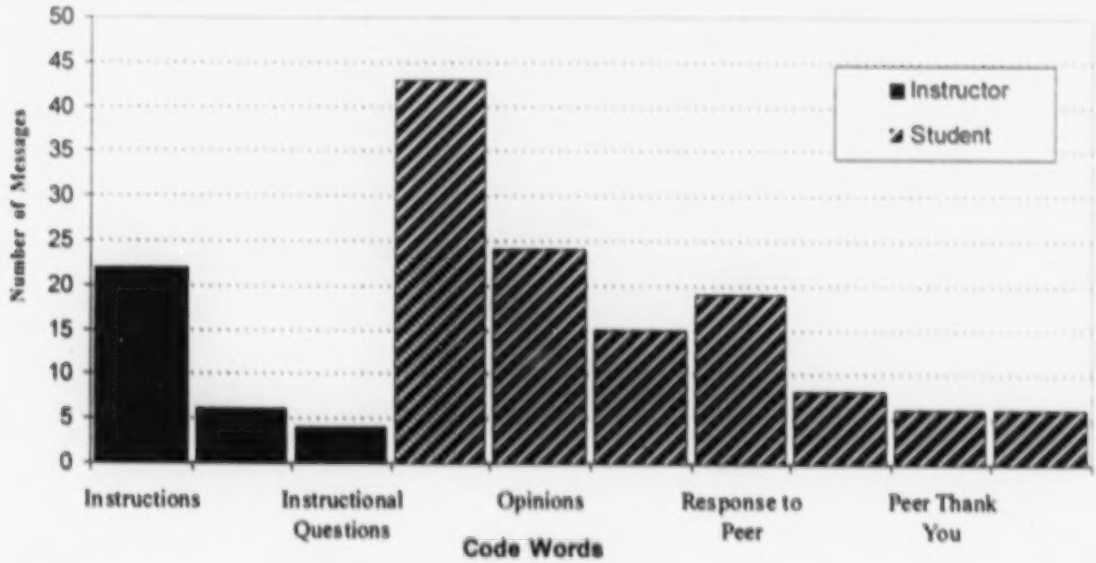


Figure 4: Instructional Conferences (Case Studies, Virtual Meetings, Class Files, Site Visits, Culture)



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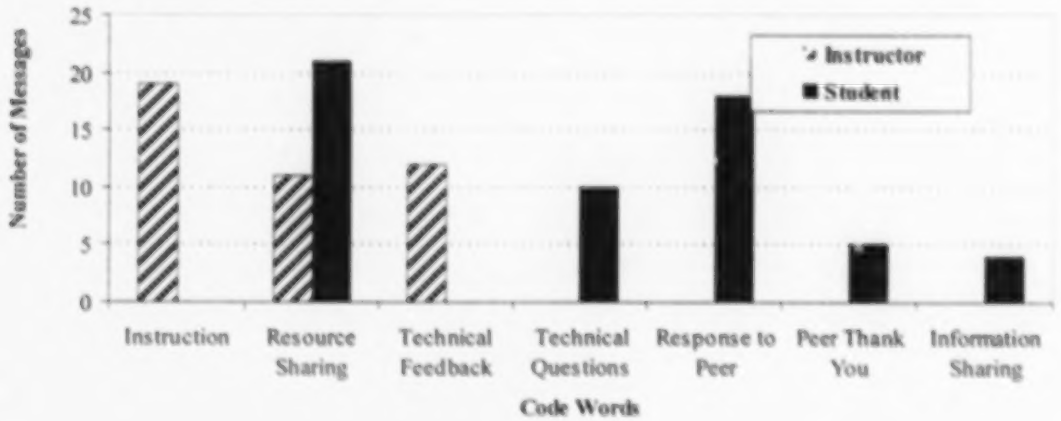
Because the metacognitive conferences consisted of individual reflection rather than reactions to others, Figure 6 summarizes these conferences in terms of the types of reflections that the participants posted. After setting up the conferences, posting forms (like the formative evaluation form), and requesting feedback, the instructor played an insignificant role in these conferences and is therefore not included in the figure. The most frequent type of interaction in this conference type was student reflections on "Instructional Strategies."

Figure 5. Auxiliary Computer Conferences
(Read Me First, The Internet, Hardware& Software, Technical ! & A, Mistakes, Howdy)



In addition to supplying a quantitative report in Figures 3, 4, 5, and 6 on the ways in which computer conference participants interacted and communicated with each other, we address the research questions in a more qualitative manner. We do so by looking at each of the questions in turn and providing evidence through verbatim statements made by the participants themselves in conference. Abbreviations, spelling, and punctuation are printed here just as in the students' original contributions. The issues discussed are related to comparisons of communication and interaction patterns, encouraging online discussion, collaborative learning, and the role of the instructor and obstacles to successful computer conferencing.

Communication and Interaction Patterns

Online interactions share many characteristics with face-to-face education: input of ideas, class discussions, debates, and other forms of knowledge building through interaction and exchange (Harasim, 1990). We identified a number of barriers and benefits of communication and interaction in computer conferencing.

The barriers to computer conferencing were dramatic. Students experienced an initial constraint as a result of having to type all comments, a process that "requires an adjustment to a new form of communication (i.e., using keyboard to communicate with short statements, learning to pause for feedback, etc.)" [S1, CJ, 12/6/96]. They quickly discovered that the steep learning curve was greater for students whose first language is not English and for those with poor typing skills. All of the students found managing large amounts of information and communication to be a challenge.

This reliance on text-based communication provided several benefits, however, which in most cases were benefits that the students learned through the process of computer conferencing. For example, students learned to verbalize their thoughts textually using the delay in the asynchronous discourse to reflect upon the content and the issue of time:

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> Although computer-mediated conferencing and email are instant delivery media, the human part - thinking it over and responding still takes time. It some cases it can take longer when responding to email or a conference electronically than doing it in person. We tend to be careful of what we put down if it is saved and displayable for others to see. [S6, FE, 10/2/96]

Because the immediate response time found in face-to-face environments did not exist, they adapted their textual communications to become more descriptive, detailed, and reflective. Students compared their own behaviors in computer conferencing with those in face-to-face environments, recognizing that in the computer conferencing environment "off-task" behaviors are more obvious,

> I remember making some of those off task comments during the chat. When you think about it those side comments are the equivalent to speaking out in class interrupting another conversation with a totally out of place comment... However there seems to the ability to ignore some of this because you can always see what the people on-task are saying and document what the off-task people are doing :) [S2, CJ, 11/23/96].

Such comparisons of communication and interaction in computer conferencing and face-to-face instructional environments indicate that when encouraged to do so, students become aware of communication patterns that take place in their conferences and even become critical of their own behaviors

Encouragement of Online Discussion

The medium of exchange in computer conferencing tends to encourage discussion by allowing participants to learn at their own pace and reflect before replying to a message. Live chats were observed to help draw out students who were traditionally quiet in the face-to-face classroom environment. Once students overcame obstacles like inadequate access to hardware and software, technical problems, and discomfort with new telecommunications software, they remarked that computer conferencing allowed them to have discussions that fostered learning, and they suggested strategies for moderating effective conferences and online chats. Barriers to online discussion included the fact that the speed of typing is slower than verbal interaction, and that threads of the discussion can become confusing if not actively managed. The advantages of this form of communication included: students had more time to read, reflect, write, and revise their ideas; traditionally quiet students tended to increase expression and communication; students were provided with an immediately relevant mechanism for sharing strategies for effective conferencing; and the communication of the formal classroom meetings was enhanced by augmenting discussions and exchange of ideas.

Collaborative Learning Strategies

Researchers suggest that the very nature of computer conferencing—its capacity to support interaction between and among students and teachers—fosters a collaborative approach to learning. Collaborative learning refers to "any activity in which two or more people work together to create meaning, explore a topic, or improve skills" (Harasim et al., 1995, p. 30). In an educational environment, collaborative learning "means that both teachers and learners are active participants in the learning process; knowledge is not something that is 'delivered' to students, but rather something that emerges from active dialogue among those who seek to understand and apply concepts and techniques" (Hiltz, 1994, p. 23).

Barriers to collaborative learning included differences in team member contributions and variability in access to computer equipment. As adult learners, each of the graduate students balanced outside work, family, and schedules that impacted their timing and frequency of participation. The advantage of using computer conferencing with these adult learners is that they were able to participate in collaborative learning projects at the time and place most convenient for them. Some students accessed FC from remote locations and some used equipment located on the campus. Remote students generally experienced greater barriers to access to computer equipment than did on-site students.

Advantages to computer conferencing are that it supports instruction by allowing for communication outside of class time, and it fosters collaborative learning by providing time and place independent communication vehicles for instructor and students. Students commented that the collaborative structure of the conferences helped them advance academically and made them feel part of a larger group. An example of one collaborative learning strategy concerned the student's discussion of the problems and frustrations related to managing the many sources of information including email, voice mail, paper mail, beepers, and other electronic sources of messages and interruptions. Students shared intellectual, practical, and emotional strategies for dealing with information overload in our modern technological environment. While weaving a conference, a student moderator wrote that his

classmates had contributed a number of good ideas and strategies for dealing with the volume of information coming from today's technologies.

Instructor's Role in Computer Conferencing

The instructor's role in a computer conferencing environment tends to be different from face-to-face instructional settings. Through CC, an instructor may provide guidance or communication to students privately, without drawing attention to the action as in a face-to-face classroom by taking students aside or asking them to stay after class. An instructor may also more equitably post equal-access announcements to students outside of the classroom environment through email distribution to the enrolled students. Students recognized that prompt feedback on assignments is an advantage of online class conferences. Additionally, advance planning and a clear structure help the students concentrate on the content of real-time chats.

The instructor's role in a computer conferencing environment is different from face-to-face instructional settings (Gunawardena, 1992). In computer conferencing, the instructor must spend significantly more time on a more frequent basis responding to the constant evolution of the online processes (Weiss & Morrison, 1998). One student remarked in the discussion section of an instructional conference that prompt feedback on assignments is an advantage of online class conferences:

For those of us at distant sites, sending in hard-copy papers and waiting for them to be mailed back in the "traditional mode" is often a process that takes weeks - in the meantime additional assignments are done without feedback from the first. By putting our work in FirstClass, we have the benefit of feedback before any more assignments are due - and using all recycled electrons! [S9, SV-D, 9/16/96]. Similarly, advance planning and a clear structure help the students concentrate on the content of their conferences. One student remarked in the final entry of his reflective journal (which the students kept in FC throughout the semester):

> Dr. M's arrangement for group and individual time, with specific instructions on how each is to be carried out, really helps to keep the computer conferencing focused and moving forward while encouraging everyone to participate. [S1, CJ, 12/6/96].

Those who have incorporated computer conferencing into university courses recognize that an immense amount of advance planning, structure, and provision for training on hardware and software are necessary for the communication and interaction to be beneficial to learners (Gunawardena, 1992; McIsaac & Ralston, 1996; Murphy, Cathcart, & Kodali, 1997). This study found that in addition to giving prompt feedback, providing advance planning and clear structure, and planning for hardware and software training, the instructor must play a variety of roles including those of facilitator, coach, guide, expert resource, and arbitrator.

Conclusions and Relevance to the Field

Computer conferencing is an information tool, a communication tool, and a generative tool that fosters creativity and problem solving (Jonassen, 1996). It offers an effective and efficient means of providing information, generating ideas, and communicating to the users. Easy-to-use software features allow the user to concentrate on the content rather than the mechanics of the computer conferencing environment. Computer conferencing supports active, self-directed learning using a structure that is easily modified to fit the different needs of learners and the instructor. Sharing ideas, discussing experiences, and clarifying concepts in the synchronous and asynchronous computer conferencing environment promotes interaction among the students and the instructor. These interactions encourage discussion and reflection, provide accessibility at any time, and stimulate critical thinking, application, and synthesis.

Current periodicals, listservs, and scholarly research have focused increased attention upon the use of computer conferencing to enhance learning (cf., Yakimovicz & Murphy, 1995). Computer conferencing is an important educational tool because of its effect on learning processes, changing rules of communication, and impact on how students enhance their knowledge. If knowledge is defined as the capacity for effective action, computer conferencing is a rich learning environment for student enhancement of knowledge through action.

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